



Engineering
Prevention



Medical
Treatment

San Diego County Trauma System

CIREN Center

CIREN Program Report



San Diego County
Administration
Center



Children's
Hospital &
Health Center



Scripps Mercy
Hospital



Palomar
Medical Center



Scripps Memorial
- La Jolla



Sharp Memorial
Hospital



UCSD
Medical Center

Commitment

The San Diego CIREN center is committed to saving lives, and mitigating and preventing serious injuries. CIREN is in a unique position to accomplish these goals through multidisciplinary review of motor vehicle crashes. It is able to identify how injuries occur and how they may be prevented either by changes in engineering design or occupant safety education. These primary prevention actions will decrease the occurrence of injuries and reduce their severity. Additionally, CIREN findings can be utilized to limit injury sequelae by improving triage, transport and treatment of motor vehicle crash (MVC) occupants. CIREN identification of injury patterns stratified by crash configuration, is provided to prehospital providers and nurses and physicians responsible for making triage and transport decisions for victims of MVCs. The CIREN research can then be used to assist in the early medical treatment of these patients.

Introduction

The San Diego region is rich in diversity. San Diego County, the fifth largest county in the United States, is home to 2.8 million residents and approximately 1.8 million licensed drivers. Covering 2.7 million acres, San Diego County has over 7,700 miles of roadways, 600 miles of which is made up of state highways. San Diego County is bordered by the Pacific Ocean to the west, Camp Pendleton to the north, the Anza-Borrego desert to the east, and the U.S.-Mexico border to the south. These boundaries insulate San Diego from adjacent regions thereby becoming a natural laboratory for research. In fact, because San Diego has highly urbanized areas as well as rural areas the CIREN team is exposed to a wide range of crash configurations, from T-bone crashes in red light run-

ning cases to potential delayed notification for crashes occurring in the less densely populated areas.

Trauma System Participation

The San Diego CIREN Center is a collaborative effort between the six regional Trauma Centers and the County of San Diego, Health & Human Services Agency, Division of Emergency Medical Services. The unique configuration of the San Diego CIREN program, incorporating six hospitals rather than one, presents logistical challenges for its participants but also offers research outcomes rich in rewards.

The CIREN Program was established in 1996 through the General Motors Corporation settlement agreement and is currently underwritten through a Cooperative Agreement with the NHTSA. The Principal Investigators for the project are:

- Gail F. Cooper, Administrator, County of San Diego Office of Public Health
- A. Brent Eastman, M.D., Chief Medical Officer of Scripps Health and the N. Paul Whittier Chair of Trauma at Scripps Memorial Hospital - La Jolla
- David B. Hoyt, M.D., Chief, Division of Trauma and the Monroe E. Trout Professor of Surgery at the University of California San Diego (UCSD) Medical Center

Other key personnel include:

- Sharon E. Pacyna, RN, BSN, MPH, Project Manager
- Steven M. Erwin, Crash Investigator
- Teresa M. Vaughan, RN, BSN Assistant Project Manager

The Principal Investigators and program coordinators are supported by the Trauma Medical Directors and nurse administrators, researchers and case managers at the county's trauma centers. The participating Trauma Centers are:

- Children's Hospital and Health Center, San Diego (Pediatric Center)
- Palomar Medical Center
- Scripps Mercy Hospital
- Scripps Memorial Hospital – La Jolla
- Sharp Memorial Hospital
- University of California San Diego (UCSD) Medical Center

The San Diego CIREN program benefits from the seventeen-year working relationship of the San Diego Trauma System. The trauma system partners include the six Trauma Centers, the Division of Emergency Medical Services (EMS) and the Office of the Medical Examiner. Established in 1984, San Diego's trauma system is nationally recognized for its pioneering efforts, not only in patient care, but for its integration between EMS and Public Health and its strides in quality improvement activities. Personnel from the County of San Diego, Emergency Medical Services provide administrative and managerial oversight to the CIREN project. The trauma system participants have engaged in collaborative efforts to improve the triage, transport and treatment of injured patients, including motor vehicle crash occupants.

Quality Assurance Network (QA Net)

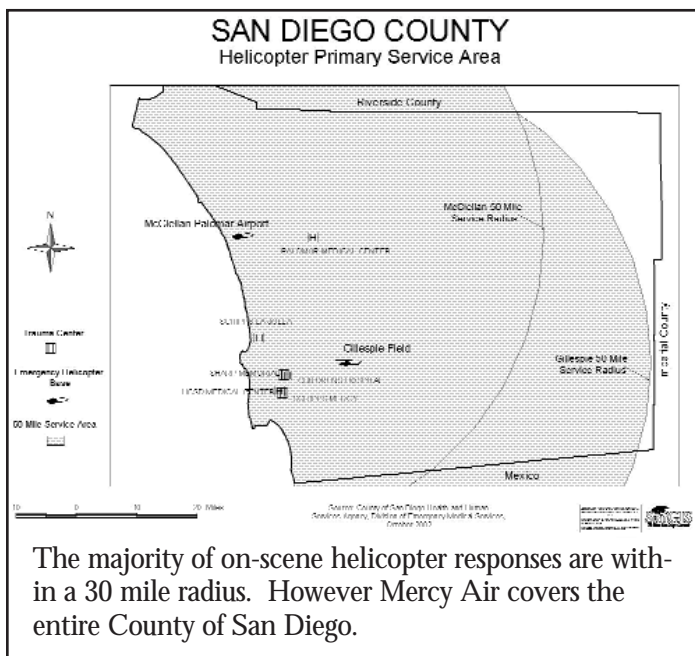
In addition to their participation in the Trauma System, EMS has on-line access to all prehospital provider data. Housed in the office of EMS is a wide area network computer system, linking prehospital providers with Emergency Departments in a real time prehospital patient information system identified as the QA Net.

The San Diego CIREN system uses the QA Net to assist personnel in identifying potential candidates. The QA Net is queried daily to track all MVC patients transported to one of the six trauma centers. This data is forwarded to the nurse managers at each trauma center and they use it as a guide to screen patients.

Information is maintained in a database and evaluated for exclusion criteria and since 1999 the San Diego CIREN Center has screened over 17,000 MVC transports. Not all exclusion reasons are tracked for every patient. Once it has been discovered the occupant does not meet criteria, the reason is entered into the database. For example, if the patient is transported to the Emergency Department (ED) and discharged, it is apparent the severity of injury is not adequate for study entry. This is reflected in Table 1 in the Minor Injury category which includes discharges from the ED as well as patients who do not have Abbreviated Injury Scores (AIS) of three or greater.

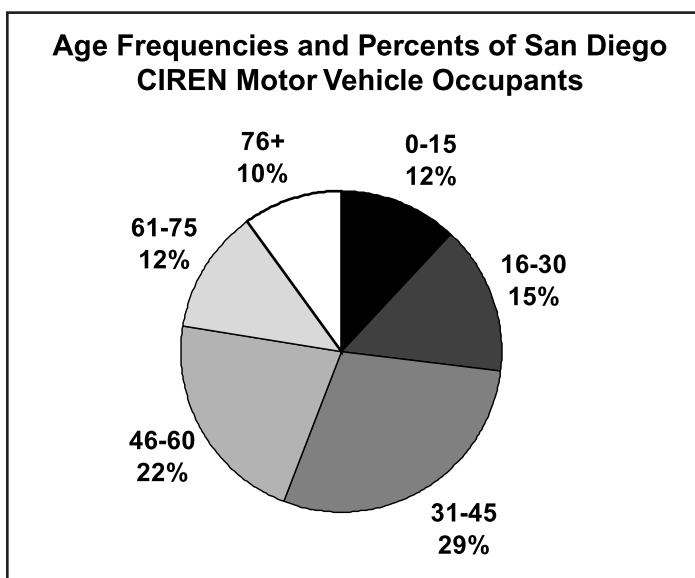
Table 1. San Diego CIREN Motor Vehicle Crash Victims, 1996–2001

Year	Screened victims	Inclusions	Exclusions	Reasons for Exclusion	
1996	(not available)	2			
1997	(not available)	40			
1998	(not available)	54			
1999	5522	46	5476	Minor injury (ED D/C 72%, AIS< 3 28%)	73%
				Crash Type	9%
				Vehicle exclusions	4%
				Consent issues	0.4%
2000	6037	48	5989	Minor injury (ED D/C 71%, AIS< 3 29%)	79%
				Crash type	6%
				Vehicle exclusion	3%
				Consent issues	0.7%
2001	6106	42	6067	Minor injury (ED D/C 71%, AIS< 3 29%)	81%
				Crash Type	6%
				Vehicle exclusions	3%
				Consent issues	1.2%
Total	17665+	232	17532+		



Prehospital Transport

The County of San Diego Division of Emergency Medical Services (EMS) is the primary regulatory agency for the local integrated emergency medical services (EMS) system. EMS coordinates activities of prehospital and trauma care services for San Diego County residents and visitors. County ambulance service providers respond to more than 250,000 calls annually. There are more than 6,000 emergency medical technicians (EMT-I's), defibrillation personnel (EMT-D's), paramedics (EMT-P's), and mobile intensive care nurses (MICN's) in San Diego County. The EMT's are employed by advanced life support (ALS) ambulance providers (17), including air medical providers and basic life support (BLS) ambulance providers (15). Prehospital transports are directed to one of 24 emergency receiving hospitals including trauma centers (6) and base hospitals (8).



Helicopter transfer is an important means of transport in San Diego County for victims of motor vehicle crashes. Crashes in rural areas, involving seriously injured patients or patients with a high risk for occult injuries often utilize the county's Mercy Air helicopter service to expedite transport to a trauma center. The County of San Diego protocol requires a first responder to evaluate the occupants and crash dynamics before a helicopter can be dispatched. In San Diego the first responders are well trained and arrive at a decision quickly. The problem arises if there is a delay between the time of the crash and the time of crash discovery. These situations would benefit enormously from the Automatic Crash Notification (ACN). Additionally, in some rural areas in the United States, where first responders may be volunteers, the level of education regarding crash configurations and risk of occult injury may not be equal to full-time professionals.

In these instances the URGENCY Algorithm system would be an important asset in determining whether the victims can be transported by land, or whether a helicopter should be dispatched. In San Diego County helicopters are also frequently used in urban and suburban areas during rush hour traffic when highway congestion would delay land transport times. In calendar year 2001 Mercy Air transported approximately 490 motor vehicle crash occupants to area hospitals.

Detection and Analysis of Emerging Injury Patterns

To date, the San Diego CIREN Program has enrolled 260 motor vehicle occupants in the research project. Of these 139 (53%) were males, 121 (47%) were females; 227 (87%) survived the crash, 22 were dead on scene and an additional 11 occupants died in the hospital. The ages of the occupants ranged from 11 months to 87 years with an average age of 39 years. Vehicle drivers totaled 180 (69%) of the enrolled occupants, right front seat passengers numbered 57 (22%), and 23 (9%) were backseat passengers. Recent passenger safety education has stressed placing children in the backseat of the vehicle. Of our case occupants ages 11 months to 11 years 60% were seated in the backseat. Fortunately only two of the front seat children had serious injuries.

The San Diego CIREN team has conducted in-depth analysis for an array of injury patterns. A few of the most significant areas of research include mediastinal injuries, diaphragm injuries, and side impact injury patterns, with and without airbags.

Our research pursuits in these specific injury realms stem from our interest in areas where the edge of current safety standards may be exceeded by distinct crash configurations and patterns. By determining these patterns CIREN can make a contribution to the body of knowledge of crash dynamics.

In addition to incorporating all of the National Automotive Sampling System (NASS) data elements, the national CIREN database houses detailed descriptions and images of occupant injuries. CT scans, x-rays, operative pictures and anatomic injury classification permit all CIREN participants to evaluate injury details and analyze them for trends and patterns. No other database integrates crash data with this degree of detailed injury description. Large integrated databases are essential in determining injury biomechanics, injury sources and finally determining methods to prevent or mitigate injury occurrence.

Outreach Efforts for the Prehospital and Medical Community

In keeping with the NHTSA and CIREN goals of reducing the incidence of mortality and morbidity from motor vehicle crashes, San Diego has stepped-up its efforts to bring CIREN findings to the professionals who take care of MVC victims. Making triage decisions regarding appropriate transport destination is key to saving lives and ensuring that medical treatment will result in the best possible outcome.

X-ray of Fractured Left Ankle



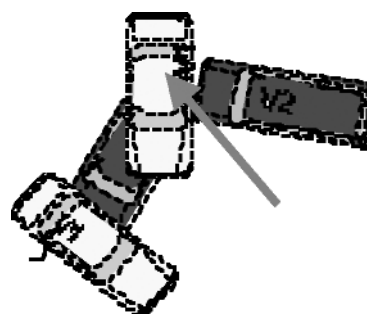
Initially, CIREN impacted transport guidelines by providing input to a county-wide task force responsible for determining triage guidelines for all prehospital providers and Emergency Department personnel. The CIREN crash investigator provided education to task force members resulting in the adoption of a triage algorithm incorporating intrusion and deformation parameters. The triage

guidelines assist personnel in determining whether the MVC occupants require the resources of a trauma center.

To reinforce the new triage guidelines, CIREN personnel conducted outreach reviewing the specifics of the new policy. Included in the presentations were digital images of vehicles depicting intrusion and deformation matching the countywide criteria as well as the injuries associated with the specific vehicle damage. Prehospital providers vocalized their interest in the presentation topics because they related to their everyday work and helped explain the source of injury patterns they observed in their professional practice.

CIREN also used these forums to provide information about specific crash configurations and the corresponding occupant kinematics. Research findings were presented

Graphic representation of vehicle impact depicting a principal direction of force of 320 degrees and vehicle point of rest.



including occult liver/spleen injuries associated with shoulder belt-only crashes, examples of occult aortic injuries, and side airbag protection systems.

Other areas of emphasis include occult injuries often encountered in offset frontal crashes with shoulder belt only use. This knowledge can assist

providers in choosing the correct transport destination and assist treating physicians with quickly diagnosing the injuries.

Education regarding “double impacts” has met with a favorable response. Prehospital personnel, assessing the scene of a crash, may be lulled into believing an occupant’s injuries are less severe because they identify that an airbag has deployed. However, if the first impact was of sufficient magnitude to deploy the airbag and a second impact was encountered during the crash, the occupant may have had less protection (if a seatbelt was used) or no protection (if a seatbelt was not used) at the time of the second impact.

Prehospital personnel are also reminded that unbelted backseat occupants can easily load front seat occupants in frontal crashes potentially increasing the injury severity.

San Diego CIREN has also incorporated information regarding the proper use of child restraint systems. A CIREN participant has worked on a statewide committee to incorporate child seat information on the California EMS Authority web page, encouraging prehospital providers to become involved in injury prevention activities for pediatric motor vehicle occupants.

Costs Related to Motor Vehicle Occupants

Table 2 uses a NHTSA formula to project motor vehicle crash costs for 1996 - 2001 San Diego CIREN patients. The NHTSA cost figures are based on a report entitled “The Economic Impact of Motor Vehicle Crashes, 2000”. Unit costs are sorted by the occupant’s highest Abbreviated Injury Score (AIS), which is an indicator of patient injury severity. Please note the NHTSA 2000 figures are national averages and do not reflect the actual costs in San Diego. The NHTSA economic cost components include productivity losses, property damage, medical costs, rehabilitation costs, travel delay, legal and court costs, emergency service costs, insurance administration costs, premature funeral costs and costs to employers. Although these costs do not

include estimated values for pain and suffering experienced by patients and their families, they do provide an indication of the strictly economic impact of motor vehicle crashes.

Table 2			
Severity per AIS	CIREN Patients by MAIS	NHTSA Cost Formula per AIS	Estimated Costs for San Diego CIREN Patients
2000			
1	3	\$5,941	\$17,823.00
2	8	\$62,020	\$496,160.00
3	26	\$178,358	\$4,637,308.00
4	5	\$337,301	\$1,686,505.00
5	4	\$1,077,567	\$4,310,268.00
6	2	\$957,787	\$1,915,574.00
	TOTAL		\$13,063,638.00
2001			
1	0	\$5,941	\$0.00
2	2	\$62,020	\$124,040.00
3	29	\$178,358	\$5,172,382.00
4	7	\$337,301	\$2,361,107.00
5	2	\$1,077,567	\$2,155,134.00
6	2	\$957,787	\$1,915,574.00
	TOTAL		\$11,728,237.00
1996-2001			
1	14	\$5,941	\$83,174.00
2	20	\$62,020	\$1,240,400.00
3	129	\$178,358	\$23,008,182.00
4	36	\$337,301	\$12,142,836.00
5	29	\$1,077,567	\$31,249,443.00
6	11	\$957,787	\$10,535,657.00
	TOTAL		\$78,259,692.00

San Diego CIREN Presentation Roster 2001-2002

National Presentations/Posters

August 22, 2002, Airbags in lateral crashes and the Boeing Survival Award

Audience: CIREN Quarterly Meeting, Seattle, WA. MD's, RN's, Prehospital Providers, Engineers, Automotive Manufacturing Executives and Researchers

Speakers: David B. Hoyt, MD and Steven M. Erwin

April 25, 2002, Brain Injury; the Role of Directionality

Audience: CIREN Quarterly Meeting, Washington D.C. MD's, RN's, Engineers, Automotive Manufacturing Executives and Researchers

Speakers: A. Brent Eastman, MD, Thomas A. Gennarelli, MD, and Steven M. Erwin

December 6, 2001, Injuries in the Elderly

Audience: CIREN Quarterly Meeting, Washington D.C. MD's, RN's, Engineers, Automotive Manufacturing Executives and Researchers

Speakers: Sharon E. Pacyna RN, MPH and Steve Erwin, Crash Investigator and Mary Kracun, BSN, PhD.

San Diego CIREN's presentation focused on San Diego CIREN crashes involving elderly occupants. Compared culpability of elderly versus non-elderly drivers and compared similar crashes involving young and old subjects.

Oct. 18-20, 2001, Orthopedic Trauma Association 17th Annual Meeting San Diego – Poster Session

Audience: Over 600 orthopedic surgeons, nurse practitioners, and nurses attended the conference.

Presenters: Sharon E. Pacyna, BSN, MPH, Steven M. Erwin, Crash Investigator, Teresa M. Vaughan, RN, BSN, Mary Kracun, BSN, PhD

Presentation included a Poster Session with an overview of the national CIREN Program and a continuously playing PowerPoint presentation which depicted occupant kinematics, vehicle reconstruction, crash video clips and case presentations. Additionally, a crashed vehicle was displayed with contour gage and calibrated rods sticks demonstrating crush and deformation.

June 21, 2001, Emergency Department Personnel – Piecing it Together

Audience: CIREN Quarterly Meeting, Washington D.C. MD's, RN's, Engineers, Automotive Manufacturing Executives and Researchers

Speakers: Sharon E. Pacyna RN, MPH and Steve Erwin, Crash Investigator

San Diego CIREN's presentation developed for Emergency Department personnel includes CIREN overview, basic crash dynamics, and patient inclusion criteria. It emphasized the importance of injury documentation and crash details. Crash dynamics associated with injury patterns was discussed.

Mar. 16, 2001, Real Life Injuries in Offset Frontal Crashes

Audience: CIREN Quarterly Meeting, Washington D.C. MD's, RN's, Engineers, Automotive Manufacturing Executives and Researchers.

Speakers: A. Brent Eastman, MD and Steve Erwin, Crash Investigator

Review of San Diego CIREN incidence of FY offset frontal crashes including patient outcome. Presentation of two off-set frontal crashes with vehicle and occupant simulations.

Regional/Local

Jul. 25, 2002, UCSD Critical Care Conference

June 15, 2002, Outreach Presentation for American Medical Response

June 22, 2002, Outreach Presentation for American Medical Response

May 7, 2002, Outreach Presentation for Poway Fire Department

Apr. 18, 2002, Outreach Presentation for Poway Fire Department

Apr. 19, 2002, Outreach Presentation for Poway Fire Department

Mar. 4, 2002, Outreach Presentation for Carlsbad Fire Department

Mar. 1, 2002, Outreach Presentation for Carlsbad Fire Department

Jan. 31, 2002, Outreach Presentation for Tri-City Field Care Audit

Jan. 30, 2002, Outreach Presentation for Tri-City Field Care Audit

Jan. 29, 2002, Outreach Presentation for Tri-City Field Care Audit

Dec. 21, 2001, Outreach Presentation for Rancho Santa Fe Fire Dept

Oct. 22, 2001, Vehicle Intrusion And Crush As Indicators For Trauma Triage

Sep. 3, 2001, CIREN Update: Side Impact Case Presentations

Jun. 15, 2001, The Case of the Human Crash Dummies

Mar. 6, 2001, What Really Happens to You When You're in a Crash!

Feb. 13, 2001, Vehicle Intrusion and Crush as Indicators for Trauma Triage